

easily mounted in a convenient corner of the chassis, using double-sided adhesive pads.

The circuit has been air-tested in the FT221 and the Trio TR7010, with excellent results, and reports from distant stations have been very gratifying. On the FT221 it has been found quite simple to mount a miniature toggle switch for S1 in an empty space on the front panel. On the author's TR7010 the noise blander has been permanently wired "on", and the NB push-button on the front panel, which conveniently happens to be of the changeover variety, is now used to select the pip-tone when required. No doubt similar facilities will be found on other equipment.

Doubtless, someone will come up with a simpler method of

producing a pip-tone, but it was felt that this circuit permits "doing-it-yourself" with an interesting little exercise in logic, which others might like to copy, modify, or extend.

Acknowledgements

Thanks are due to colleague Brian Wilkie (Motorola) for circuit discussions, and to Bernie, GM8NXW, who has assisted with tests on the FT221.

References

- [1] *Radio Communication* February 1978, p112.
- [2] *Motorola Semiconductor Data Library* Vol 5, Series B.

Anti-tvi filters

by V. ROSSI, I4QQE/F0BJT*

Introduction

This article describes two filters useful for the elimination of tv interference (tvi) and broadcast interference (bci), among the sources of which are:

- (1) Harmonics of the transmitter which fall into one or more tv (or bc) channels (trouble depending on the frequency of emission).
- (2) Saturation of the input stage of the receiver (troubles not depending on the working frequency). This problem is becoming more and more frequent, especially with certain broadband antenna amplifiers and with semiconductor devices. Lack of selectivity of the input stage and sometimes the poor choice of the working point of the device(s) aggravates the situation. As a general rule, valves are less sensitive to this phenomenon than semiconductor devices, since the potentials employed are higher and the dynamic range is better.

The author offers the following suggestions which could help amateurs having trouble with tvi:

- (1) Filter the mains power supply socket.
- (2) Ground the transmitter chassis.
- (3) Feeders. Often the antenna radiator itself is a balanced device, while the more frequently used feeders (coaxial cables) are unbalanced systems. A few manufacturers offer antennas (with symmetrical radiators) fed directly by a coaxial cable without using balanced to unbalanced transformers (baluns). They state that the radiation pattern is still symmetrical, but in this way one creates rf currents flowing *outside* the braid in

such a way that the cable can radiate, especially if its length resonates at the working frequency. Such an installation is a potential source of tvi and bci.

In the author's antenna installation, tests made before and after placing baluns gave the same antenna efficiency, but the rf in the shack fell almost 20dB. In fact, he attached an indoor antenna to the scope used to monitor his signal on the air, and the strange "tingling" felt when touching the transceiver (when transmitting) disappeared (it was not the 220V!).

Low-pass filter (for transmission)

A constant k low-pass filter suitable for transmission is described below. With this, one can obtain about 20dB/octave per section (ie the output voltage falls by a factor of 10 each time the frequency is doubled) and, consequently, 60dB at twice the cut-off frequency for three sections.

The two principal reasons for the choice of this type of filter are: (a) no tuning is necessary; and (b) the attenuation increases with the frequency without passing through maxima and minima (Fig 2). One can recalculate the filter for different frequencies and/or impedances.

$$R = 50\Omega, f_c = 34\text{MHz},$$

$$L_a = \frac{R}{\pi f_c} = 0.47\mu\text{H},$$

$$C_a = \frac{1}{2\pi f_c R} = 94\text{pF}$$

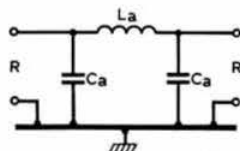


Fig 1. Constant k low-pass filter circuit (section)

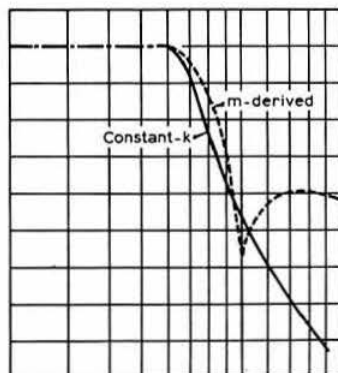


Fig 2. Comparison between a constant k and an m-derived filter (arbitrary scales)

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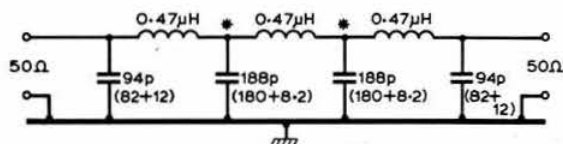


Fig 3. Complete schematic diagram of the low-pass filter. Coils: 8t 1.5mm enam copper wire, 14mm dia, 21mm long

Note that the maximum voltage which will develop in the filter is at the points marked * where, at about 30MHz, the voltage doubles in respect of the input voltage. For this reason the minimum working voltage must be for a given P_{RMS} (that read on the wattmeter):

$$V_p = 2 \cdot \sqrt{2} \cdot \sqrt{P_{RMS} \cdot R}$$

To have a safety margin it is good practice to double this value.

The filter was built in an aluminium diecast box, the different sections being screened from each other. The author used 1,000V feedthrough capacitors, wired in parallel to obtain the required value. Other types of capacitors are also suitable, provided their maximum voltage ratings are not exceeded.

High-pass filter (for reception)

When the interference is due to the overloading of the input stage (for both tv and bc sets), the only solution is to remove the interfering signal. The network must reject the undesired

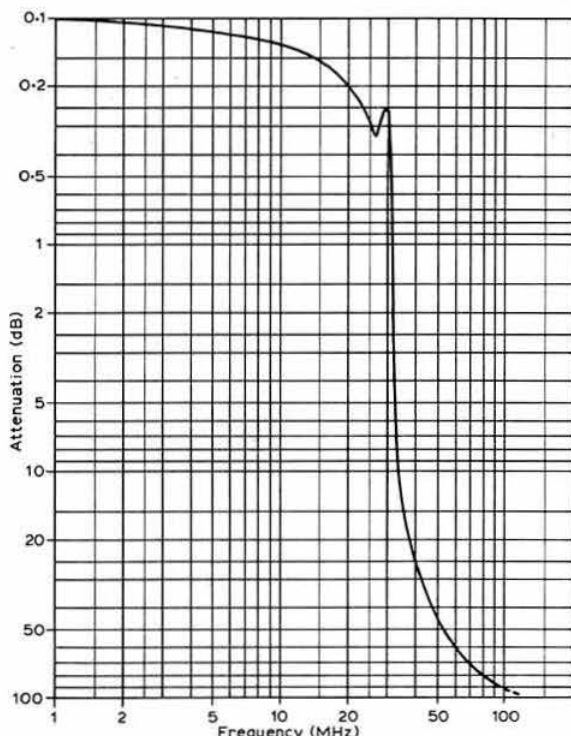


Fig 4. Attenuation curve of low-pass filter. Final attenuation >90dB at 250MHz, >70dB at 500MHz

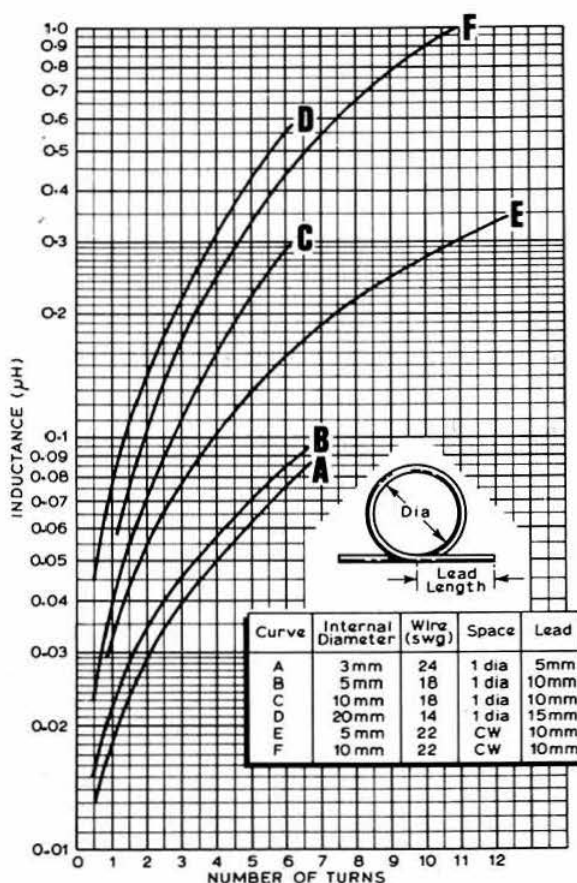


Fig 5. Characteristics of small inductors

signal by at least 30dB, since one does not know its intensity beforehand, and to have a margin if one increases the power.

The filter attenuates the hf signal by 40 to 70dB, and the vhf 144MHz signal by 34 to 38dB. The circuit may be recalculated for different frequencies and/or impedances, and for this reason the author has included a chart with winding data for small coils (Fig 5), reproduced from the *RSGB VHF/UHF Manual*, and thanks the Society for permission to do so.

The author works both the hf and vhf (144MHz) bands, but people not interested can omit the vhf section. He has a constant k high-pass filter (two sections) for hf, and a series-tuned circuit for vhf.

In the Geneva region the lowest tv channel is E4 (62-68MHz); the impedance is 75Ω.

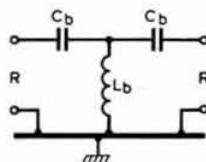
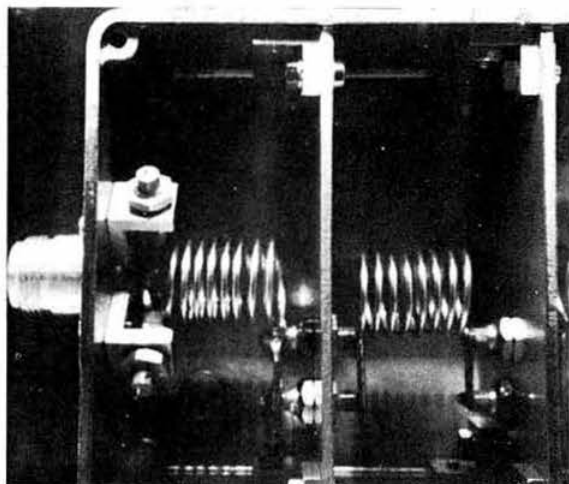


Fig 6. Constant k high-pass filter (section)



Close-up view of the low-pass filter (detail)

$$R = 75\Omega, f_c = 60\text{MHz},$$

$$L_b = \frac{R}{4\pi f_c} = 0.1\mu\text{H},$$

$$C_b = \frac{1}{2\pi f_c R} = 36\text{pF}$$

For the vhf section; $R = 75\Omega$ and $f_0 = 145\text{MHz}$

When L_c and C_c are tuned to resonance, the impedance between the points X X is very low (theor→zero). In practice there is always a series resistance R_s (mainly due to the Q of the coil) which limits the depth of the notch.

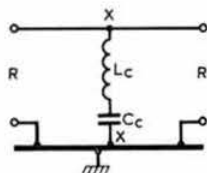


Fig 7. Series tuned trap filter

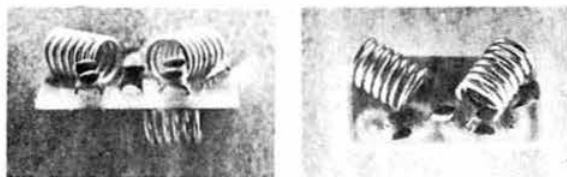
In a 75Ω system R_s must be, say, 1 or 2Ω to obtain good rejection, and so

$$Q = \frac{X_L}{R_s}$$

where: Q =quality factor of the coil

X_L =reactance of L_c at f_0

R_s =series resistance of L_c at f_0



Close-up views of the prototype high-pass filter

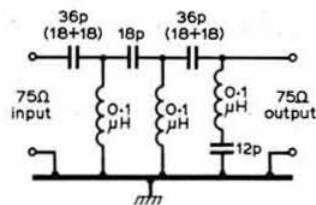
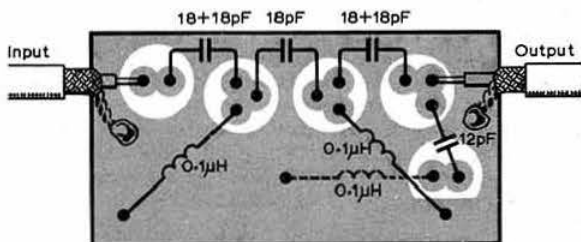


Fig 8. High-pass filter circuit. Coils: 7t 0.8mm enam or silver-plated copper wire, 5mm dia, 10mm long

A first computation with $R_s = 1.5\Omega$ and $Q = 60$ gives $X_L \approx 90\Omega$ and, consequently, $L_c \approx 0.1\mu\text{H}$.

$$L_c = 0.1\mu\text{H}$$

$$C_c = \frac{1}{4\pi^2 f_0^2 X_L} \approx 12\text{pF}$$



Single-sided printed circuit board, 27 x 14mm, viewed from copper side

Fig 9. Layout of high-pass filter

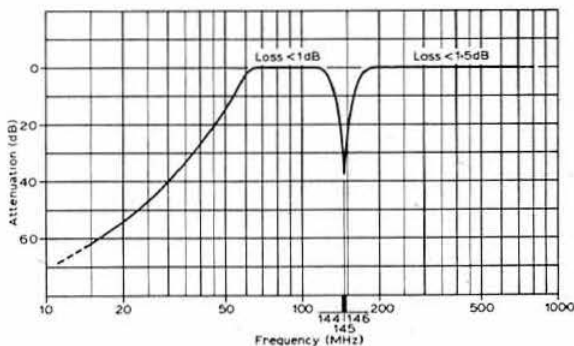


Fig 10. High-pass filter performance

The filter has been constructed on a single-sided pcb, the components being placed on both sides to avoid the mutual induction of the coils (Fig 9 and photographs). At 145MHz the tuning is carried out either by displacing the turns of L_c or by using a trimmer as C_c .

It is absolutely necessary to use a metallic box to avoid stray coupling degrading the filter performance. The filter should be installed as near as possible to the receiver input terminals to obtain maximum filtering of cable "picked-up" interference. □